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BY  
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*Professor of Chemistry in Brown University.*

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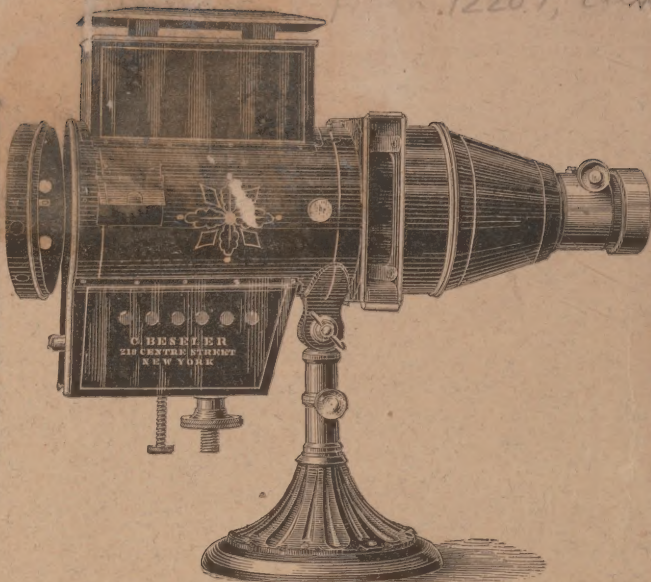
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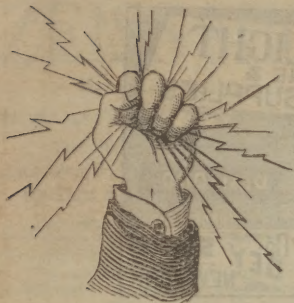
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1-4 "	20 "	"	10 "	"	2-3 "	57 "	"	15 "	"
1-3 "	36 "	"	12 "	"	2-3 "	64 "	"	17 "	"
1-3 "	50 "	"	19 "	"	4-4 "	80 "	"	16 "	"
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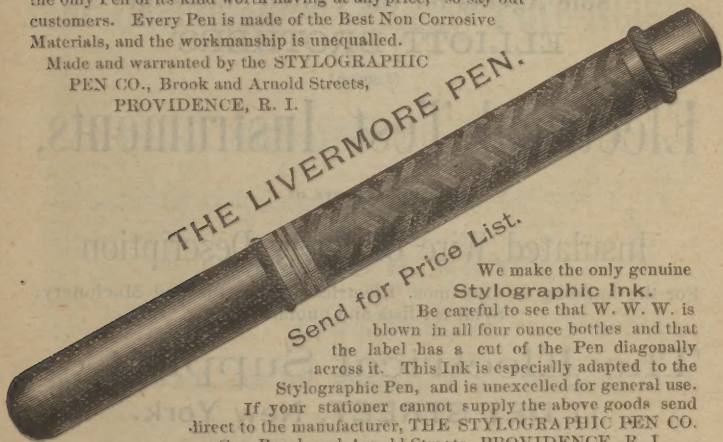
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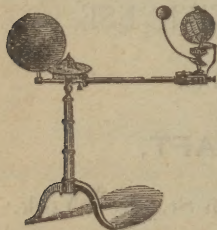
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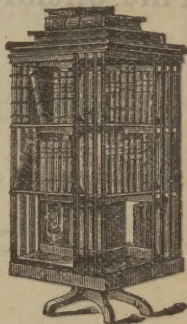


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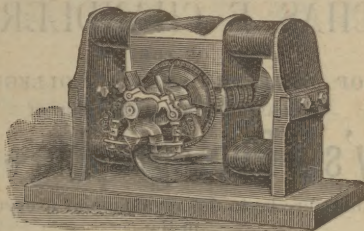
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THE  
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*Professor of Chemistry in Brown University.*

AUTHOR OF  
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QUALITATIVE CHEMICAL ANALYSIS,  
QUANTITATIVE CHEMICAL ANALYSIS.

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THE laws of nature are  
the thoughts of God.

OERSTED.

✱ CALENDAR. ✱

1885	Sunday	Monday	Tuesday	Wednes.	Thursd.	Friday	Saturd.	1885	Sunday	Monday	Tuesday	Wednes.	Thursd.	Friday	Saturd.
Jan.	...	...	...	...	1	2	3	July	...	...	...	1	2	3	4
	4	5	6	7	8	9	10		5	6	7	8	9	10	11
	11	12	13	14	15	16	17		12	13	14	15	16	17	18
	18	19	20	21	22	23	24		19	20	21	22	23	24	25
	25	26	27	28	29	30	31		26	27	28	29	30	31	...
Feb.	...	...	...	...	...	...	...	Aug.	...	...	...	...	...	...	...
	1	2	3	4	5	6	7		2	3	4	5	6	7	8
	8	9	10	11	12	13	14		9	10	11	12	13	14	15
	15	16	17	18	19	20	21		16	17	18	19	20	21	22
	22	23	24	25	26	27	28		23	24	25	26	27	28	29
Mar.	...	...	...	...	...	...	...	Sept.	...	...	...	...	...	...	...
	1	2	3	4	5	6	7		30	31	...	...	...	...	...
	8	9	10	11	12	13	14		6	7	8	9	10	11	12
	15	16	17	18	19	20	21		13	14	15	16	17	18	19
	22	23	24	25	26	27	28		20	21	22	23	24	25	26
	29	30	31	...	...	...	...		27	28	29	30	...	...	...
Apr.	...	...	...	...	...	...	...	Oct.	...	...	...	...	...	...	...
	5	6	7	8	9	10	11		4	5	6	7	8	9	10
	12	13	14	15	16	17	18		11	12	13	14	15	16	17
	19	20	21	22	23	24	25		18	19	20	21	22	23	24
	26	27	28	29	30	...	...		25	26	27	28	29	30	31
May	...	...	...	...	...	...	...	Nov.	...	...	...	...	...	...	...
	3	4	5	6	7	8	9		1	2	3	4	5	6	7
	10	11	12	13	14	15	16		8	9	10	11	12	13	14
	17	18	19	20	21	22	23		15	16	17	18	19	20	21
	24	25	26	27	28	29	30		22	23	24	25	26	27	28
	31	...	...	...	...	...	...		29	30	...	...	...	...	...
June	...	...	...	...	...	...	...	Dec.	...	...	...	...	...	...	...
	7	8	9	10	11	12	13		6	7	8	9	10	11	12
	14	15	16	17	18	19	20		13	14	15	16	17	18	19
	21	22	23	24	25	26	27		20	21	22	23	24	25	26
	28	29	30	...	...	...	...		27	28	29	30	31	...	...

If all the year were playing holidays  
To sport would be as tedious as to work.

FIRST PART-HENRY IV.

## EDITORIAL GREETING.

The third annual issue of

### THE LABORATORY HANDBOOK

is now offered for the favorable consideration of the scientific world. Many of our friends have found the previous numbers serviceable; they will discover in this one several new features that we trust will merit their approval.

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*THE EDITOR.*

---

## ASTRONOMICAL NOTES FOR 1885.

---

### ECLIPSES.

In the year 1885, there will be four eclipses, two of the sun and two of the moon.

I. An annular eclipse of the sun on March 12, visible at Washington as a partial eclipse.

#### CIRCUMSTANCES OF THE ECLIPSE.

H. M.

Eclipse begins ..... 10 00 A. M.  
Central eclipse begins ..... 11 11 "  
Central eclipse at noon ..... 1 06 P. M.  
Central eclipse ends ..... 1 43 "  
Eclipse ends ..... 3 06 "

II. A partial eclipse of the moon on March 20, invisible at Washington; visible in the Western Pacific Ocean, Asia and the eastern portion of Europe and Africa.

III. A total eclipse of the sun on September 8, invisible at Washington, but visible in the South Pacific Ocean.

IV. A partial eclipse of the moon on September 23-24, visible at Washington; also on the Atlantic Ocean, North and South America, and the Pacific Ocean.

#### TIMES OF THE PHASES.

H. M.

Moon enters penumbra ..... 11 52 P. M.  
Moon enters shadow ..... 1 00 A. M.  
Middle of the eclipse ..... 2 40 "  
Moon leaves shadow ..... 4 14 "  
Moon leaves penumbra ..... 5 28 "



JANUARY						
S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

First Month. 31 Days.

1885.

## MEMORANDA.



»* MARCH *						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
...	...	...	...	...	...	...

Third Month.

31 Days.

1885.

## MEMORANDA.



⇒\* APRIL \*⇐

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
...	...	...	...	...	...	...

Fourth Month.

30 Days.

1885.

MEMORANDA.

»* MAY *«						
S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

Fifth Month.

31 Days.

1885.

## MEMORANDA.





→* JULY *←						
S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	...	...	...	...	...

Seventh Month.

31 Days.

1885.

## MEMORANDA.



SEPTEMBER						
S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	...	...	...
...	...	...	...	...	...	...

Ninth Month.

30 Days.

1885.

## MEMORANDA.



NOVEMBER						
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	...	...	...	...	...
...	...	...	...	...	...	...

Eleventh Month.

30 Days.

1885.

## MEMORANDA.



DECEMBER						
☿	♈	♏	♏	♏	♏	♏
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

Twelfth Month.

31 Days.

1885.

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*Trinity College, Hartford, Conn.*

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*Alfred University, Alfred Centre, N. Y.*

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*Lafayette College, Easton, Pa.*

"Appleton's Quantitative Analysis seems to be an excellent work."

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**From Professor T. C. VAN NÜYS,**

*Indiana State University, Bloomington, Ind.*

"As far as I have been able to examine Appleton's Quantitative Analysis, I am very favorably impressed with it."

**From Professor A. H. SABIN, M. S.,**

*University of Vermont, Burlington, Vt.*

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**From Prof. P. de P. RICKETTS, E. M., Ph. D.,**

*Columbia College School of Mines, New York City.*

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**From Professor CHAS. A. GOESSMANN, Ph. D.,**

*Massachusetts Agricultural College, Amherst, Mass.*

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**From Professor ALONZO COLLIN,**

*University of Nebraska, Lincoln, Neb.*

"I have been using Appleton's Quantitative Analysis this session, and can say that I am much pleased with it."



**From Professor CHARLES A. SCHAEFFER, Ph. D.,***Cornell University, Ithaca, N. Y.*

"I had postponed looking over Appleton's Quantitative Analysis until I could examine it thoroughly. This I have done, and will venture to express my hearty approval of the book. For the purpose for which it is intended, that is, as a guide for beginners, it is certainly well written and thoroughly, and I shall be very glad to recommend it to all students commencing Quantitative Analysis."

**From Professor H. B. CORNWALL,***John C. Green School of Science, Princeton, N. J.*

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TABLE BASED ON THE LATEST REVISION OF  
ATOMIC AND MOLECULAR WEIGHTS.

(Derived from Professor F. W. Clarke's figures.)

NAMES OR FORMULAS.	WEIGHTS.	Approxim'e Weights.	NAMES OR FORMULAS.	WEIGHTS.	Approxim'e Weights.
Aluminum, Al.....	27.0090	27.	Cobalt, Co.....	58.8870	58.9
Al <sub>2</sub> O <sub>3</sub> .....	101.9079	101.9	Copper, Cu.....	63.1730	63.2
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (NH <sub>4</sub> ) <sub>2</sub>			CuO.....	79.1363	79.1
SO <sub>4</sub> 24H <sub>2</sub> O....	904.5280	904.5	CuSO <sub>4</sub> 5H <sub>2</sub> O....	248.8267	248.8
Antimony, Sb.....	119.9550	120.	Didymium, D.....	144.5730	144.6
Sb <sub>2</sub> O <sub>4</sub> .....	303.7632	303.8	Erbium, E.....	165.8910	165.9
Sb <sub>2</sub> S <sub>3</sub> .....	335.8620	335.9	Fluorine, Fl.....	18.9840	19.
K Sb O H <sub>2</sub> O <sub>4</sub> C <sub>4</sub> H <sub>2</sub>			Gallium, Ga... ..	68.8540	68.9
O <sub>2</sub> + 1/2 H <sub>2</sub> O....	331.5931	331.6	Glucinum, G... ..	9.0850	9.1
Arsenic, As.....	74.9180	74.9	Gold, Au.....	196.1550	196.2
As <sub>2</sub> O <sub>3</sub> .....	197.7259	197.7	Hydrogen, H.....	1.0000	1.
As <sub>2</sub> S <sub>3</sub> .....	245.7880	245.8	H <sub>2</sub> O.....	17.9633	18.
NH <sub>4</sub> Mg As O <sub>4</sub> 12			Indium, In.....	113.3980	113.4
H <sub>2</sub> O.....	396.3108	396.3	Iodine, I.....	126.5570	126.6
Mg <sub>2</sub> As <sub>2</sub> O <sub>7</sub> .....	309.4971	309.5	KI.....	165.5760	165.6
Barium, Ba.....	136.7630	136.8	AgI.....	234.2320	234.2
BaCl <sub>2</sub> + 2H <sub>2</sub> O....	243.4296	243.4	Iridium, Ir.....	192.6510	192.7
BaSO <sub>4</sub> .....	232.6002	232.6	Iron, Fe.....	55.9130	55.9
Bismuth, Bi.....	207.5230	207.5	Fe <sub>2</sub> O <sub>3</sub> .....	159.7159	159.7
Bi <sub>2</sub> O <sub>3</sub> .....	462.9359	462.9	FeSO <sub>4</sub> + 7H <sub>2</sub> O....	277.4933	277.5
BiONO <sub>3</sub> .....	285.3972	285.4	Fe SO <sub>4</sub> + (NH <sub>4</sub> ) <sub>2</sub>		
Boron, Bo.....	10.9410	10.9	SO <sub>4</sub> 6H <sub>2</sub> O....	391.4092	391.4
Bromine, Br.....	79.7680	79.8	Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (NH <sub>4</sub> ) <sub>2</sub>		
KBr... ..	118.7870	118.8	SO <sub>4</sub> 24H <sub>2</sub> O....	962.3360	962.3
KgBr.....	187.4430	187.4	Lanthanum, La....	138.5260	138.5
Cadmium, Cd.....	111.8350	111.8	Lead, Pb.....	206.4710	206.5
CdO.....	127.7983	127.8	PbO.....	222.4343	222.4
CdS.....	143.8190	143.8	PbS.....	238.4550	238.5
Cæsium, Cs... ..	132.5830	132.6	Pb(NO <sub>3</sub> ) <sub>2</sub> .....	330.2928	330.3
Calcium, Ca.....	39.9900	40.	PbSO <sub>4</sub> .....	302.3082	302.3
CaO.....	55.9533	56.	Lithium, Li.....	7.0073	7.
CaCO <sub>3</sub> .....	99.8535	99.9	Magnesium, Mg....	23.9500	24.
CaSO <sub>4</sub> .....	135.8272	135.8	MgO.....	39.9223	39.9
Carbon, C.....	11.9736	12.	MgSO <sub>4</sub> + 7H <sub>2</sub> O....	245.5393	245.5
CO.....	27.9309	27.9	Mg <sub>2</sub> P <sub>2</sub> O <sub>7</sub> .....	221.5771	221.6
CO <sub>2</sub> .....	43.9002	43.9	Manganese, Mn....	53.9060	53.9
Cerium, Ce.....	140.4240	140.4	MnO.....	69.8693	69.9
Chlorine, Cl.....	35.3700	35.4	MnO <sub>2</sub> .....	85.8326	85.8
AgCl.....	143.0450	143.	Mn <sub>2</sub> O <sub>4</sub> .....	225.5712	225.6
NaCl.....	58.3680	58.4			
Chromium, Cr.....	52.0090	52.			
Cr <sub>2</sub> O <sub>3</sub> .....	151.9079	151.9			
K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> .....	293.7991	293.8			
K <sub>2</sub> S O <sub>4</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>					
24H <sub>2</sub> O....	996.5240	996.5			

TABLE BASED ON THE LATEST REVISION OF  
ATOMIC AND MOLECULAR WEIGHTS.

(Continued.)

NAMES OR FORMULAS.	WEIGHTS.	Approximate Weights.	NAMES OR FORMULAS.	WEIGHTS.	Approximate Weights.
Mercury, Hg.....	199.7120	199.7	Rubidium, Rb.....	85.2510	85.3
HgCl <sub>2</sub> .....	270.4520	270.5	Ruthenium, Ru.....	104.2170	104.2
HgS.....	231.6960	231.7	Scandium, Sc.....	43.9800	44.
Molybdenum, Mo....	95.5270	95.5	Selenium, Se.....	78.7970	78.8
Nickel, Ni.....	57.9280	57.9	Silicon, Si.....	28.1950	28.2
NiO.....	73.8913	73.9	SiO <sub>2</sub> .....	60.1216	60.1
Ni SO <sub>4</sub> · (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> · 6H <sub>2</sub> O.....	393.4242	393.4	Silver, Ag.....	107.6750	107.7
Niobium, Nb.....	93.8120	93.8	AgCl.....	143.0450	143.
Nitrogen, N. ....	14.0210	14.	AgNO <sub>3</sub> .....	169.5859	169.6
N <sub>2</sub> O.....	107.8585	107.9	Sodium, Na.....	22.9980	23.
HNO <sub>3</sub> .....	62.9109	62.9	NaCl.....	58.3680	58.4
KNO <sub>3</sub> .....	100.9299	100.9	Na <sub>2</sub> CO <sub>3</sub> .....	105.8595	105.9
NH <sub>3</sub> .....	17.0210	17.	Na <sub>2</sub> O.....	61.9593	62.
NH <sub>4</sub> .....	18.0210	18.	Strontium, Sr.....	87.3740	87.4
NH <sub>4</sub> Cl.....	53.3910	53.4	SrSO <sub>4</sub> .....	183.2112	183.2
NH <sub>4</sub> OH.....	34.9843	35.	Sulphur, S.....	31.9840	32.
(NH <sub>4</sub> ) <sub>2</sub> PtCl <sub>6</sub> .....	442.6770	442.7	SO <sub>2</sub> .....	63.9106	63.9
Osmium, Os.....	198.4940	198.5	SO <sub>3</sub> .....	79.8739	79.9
Oxygen, O.....	15.9933	16.	SO <sub>4</sub> .....	95.8372	95.8
O <sub>2</sub> .....	31.9206	31.9	H <sub>2</sub> SO <sub>4</sub> .....	97.8372	97.8
O <sub>3</sub> .....	47.8899	47.9	Tantalum, Ta.....	182.1440	182.1
O <sub>4</sub> .....	63.8532	63.9	Tellurium, Te.....	127.9600	128.
O <sub>5</sub> .....	79.8105	79.8	Thallium, Tl.....	203.7150	203.7
O <sub>6</sub> .....	95.7798	95.8	Thorium, Th.....	233.4140	233.4
O <sub>7</sub> .....	111.7431	111.7	Tin, Sn.....	117.6980	117.7
O <sub>8</sub> .....	127.7064	127.7	SnCl <sub>2</sub> + 2H <sub>2</sub> O.....	224.3646	224.4
O <sub>9</sub> .....	143.6697	143.7	SnO <sub>2</sub> .....	149.6246	149.6
Palladium, Pd.....	105.7370	105.7	*Titanium, Ti.....	47.9997	48.
Phosphorus, P.....	30.9580	31.	Tungsten, W.....	183.6100	183.6
P <sub>2</sub> O <sub>5</sub> .....	141.7425	141.7	Uranium, U.....	238.4820	238.5
Mg <sub>2</sub> P <sub>2</sub> O <sub>7</sub> .....	221.5771	221.6	Vanadium, Va.....	51.2560	51.3
Platinum, Pt.....	194.4150	194.4	Ytterbium, Yb.....	172.7010	172.8
K <sub>2</sub> PtCl <sub>6</sub> .....	484.6730	484.7	Yttrium, Y.....	89.8160	89.8
(NH <sub>4</sub> ) <sub>2</sub> PtCl <sub>6</sub> .....	442.6770	442.7	Zinc, Zn.....	64.9045	64.9
Potassium, K.....	39.0100	39.	ZnO.....	80.8978	80.9
K <sub>2</sub> O.....	94.0613	94.	ZnSO <sub>4</sub> · 7H <sub>2</sub> O.....	286.4848	286.5
KCl.....	74.3500	74.4	Zirconium, Zr.....	89.3670	89.4
K <sub>2</sub> PtCl <sub>6</sub> .....	484.6730	484.7			
K <sub>2</sub> SO <sub>4</sub> .....	173.8752	173.9			
Rhodium, Rh.....	104.0350	104.1			

\*Thorpe, T. E., Chemical News, 48: 251.

## TABLES OF WEIGHTS AND MEASURES.

## ENGLISH WEIGHTS.

## TROY WEIGHT.

<i>Pound.</i>	<i>Ounces.</i>	<i>Pennyweights.</i>	<i>Grains.</i>	<i>French Grammes.</i>
1 .....	12 .....	240 .....	5760	= 373.2419
	1 .....	20 .....	480	= 31.1035
		1 .....	24	= 1.5552

## APOTHECARIES' WEIGHT.

<i>lb.</i>	<i>3</i>	<i>3</i>	<i>9</i>	<i>gr.</i>	
<i>Pound.</i>	<i>Ounces.</i>	<i>Drachms.</i>	<i>Scruples.</i>	<i>Grains.</i>	<i>French Grammes.</i>
1 .....	12 .....	96 .....	288 .....	5760	= 373.2419
	1 .....	8 .....	24 .....	480	= 31.1035
		1 .....	3 .....	60	= 3.8279
			1 .....	20	= 1.2959
				1	= .0648

## AVOIRDUPOIS WEIGHT.

<i>Pound.</i>	<i>Ounces.</i>	<i>Drachms.</i>	<i>Grains.</i>	<i>French Grammes.</i>
1 .....	16 .....	256 .....	7000	= 453.5926
	1 .....	16 .....	437.5	= 28.3495
		1 .....	27.343	= 1.7718

## METRIC MEASURES.

## MEASURES OF LENGTH.

1 Millimetre	=	0.001 of a metre.	
1 Centimetre	=	0.010 of a metre.	
1 Decimetre	=	0.100 of a metre	= about 4 inches.
1 Metre	=	1.000 Metre	= 39.37 inches.
1 Decametre	=	10 000 metres.	
1 Hectometre	=	100.000 metres.	
1 Kilometre	=	1,000 000 metres	= about $\frac{3}{8}$ of a mile.
1 Myriametre	=	10,000.000 metres	= about 6 $\frac{1}{8}$ miles.

## MEASURES OF SURFACE.

1 Centiare	=	1 Square metre	= about 1 $\frac{1}{5}$ square yards.
1 Are	=	100 Square metres.	
1 Hectare	=	10,000 Square metres	= about 2 $\frac{1}{2}$ acres.

## MEASURES OF VOLUME.

1 Cubic Metre	=	1000 Cubic Decimetres.
	=	1000 Litres, or one Kilolitre.
	=	1 Stere.

## MEASURES OF CAPACITY.

1 Litre	{	1 cubic decimetre,	{	= about 1 quart.
		or 1000 cubic centimetres		

## MEASURES OF WEIGHT.

1 Milligramme	=	0.001 of a gramme	=	about $\frac{1}{64}$ of a grain.
1 Centigramme	=	0.010 of a gramme.		
1 Decigramme	=	0.100 of a gramme.		
1 Gramme	=	1.000 Gramme	=	about 15 $\frac{1}{2}$ grains.
1 Decagramme	=	10.000 grammes.		
1 Hectogramme	=	100.000 grammes.		
1 Kilo(gramme)	=	1000.000 grammes	=	about 2 $\frac{1}{3}$ lbs.
1 Tonneau	=	1000. Kilo's	=	about 1 ton.



ALPHABETICAL TABLE OF EQUIVALENT VALUES OF  
WEIGHTS AND MEASURES.

1 Are = 100 sq. metres .....	119.6 sq. yards.
1 Centiare = 1 sq. metre, = 100 sq. centimetres .....	1550. sq. inches.
1 Centimetre = $\frac{1}{100}$ of a metre.....	.3937 inches.
1 Cubic centimetre; (of dist. water, weighs 1 gm.).....	.0610 cub. inches.
1 Cubic decimetre, (same as 1 litre).....	1000 C. C.
1 " " of distilled water, weighs 1000 gms., or.....	1 kilogramme.
1 " " in English or imperial measure .....	.8804 quarts.
1 " " in American or wine measure .....	1.0567 quarts.
1 Cubic foot (1728 cubic inches) .....	28,315.3119 cub. cent.
1 " " of water (at 62° F.) weighs.....	62.3210 lbs. Av.
1 Cubic inch.....	16.3861 cub. cent.
1 " " of water (at 62 F.) weighs.....	252.458 grains.
1 " " of water (at 60° F.) weighs.....	252.5 grains.
1 Cubic metre (1 Stere), = 1,000,000. C. C., or.....	1000. litres.
1 Fluid ounce, imperial, = 28.4 C. C.....	1.7329 cub. inches.
1 " " wine measure, = 29.5 C. C.....	1.8047 cub. inches.
1 " " imperial, of water (62° F.) weighs.....	437.5 grains.
1 " " wine measure, of water (60° F.) weighs.....	456.0 grains.
1 Foot .....	30.48 centimetres.
1 Gallon, imperial, = 277.274 cubic inches.....	4.5435 litres.
1 " " of water, weighs (62° F.) 10 lbs. or... ..	70,000 grains.
1 Gallon, wine measure, = 231. cubic inches.....	3.7852 litres.
1 " " of water, weighs (60° F.) 8.34 lbs. or.....	58,372.2 grains.
1 Gramme (weight of 1 C. C. of dist. water, 4° C.).....	15.4323 grains.
1 Inch.....	2.54 centimetres.
1 Kilogramme (1000 grammes).....	2.2046 lbs. Av.
1 Litre (see cubic decimetre).	
1 Metre (1 40-mill'th of Earth's meridian) 3 ft. 3 in. $\frac{3}{8}$ in., nearly.	39.3708 inches.
1 Pint, wine meas., = 16 fluid oz. = of water (60° F.) 7296.5 gr...	473.148 cub. cent.
1 " imperial, = 20 fluid oz. = of water (62° F.) 8750. gr.....	567.932 cub. cent.
1 Quart, wine measure, = 32 fluid ounces.....	.9463 litres.
1 " imperial, = 40 fluid ounces.....	1.1358 litres.
1 Ton Avoirdupois (2000 lbs.) .....	29,166 $\frac{2}{3}$ oz. Troy.
1 Tonneau, = 1,000,000 gms .....	1000 kilo's.

TABLE SHOWING CORRESPONDING DEGREES ON THE SCALES OF  
THE FAHRENHEIT AND CENTIGRADE  
THERMOMETERS.

FAHR.	CENT.	FAHR.	CENT.	FAHR.	CENT.	FAHR.	CENT.	FAHR.	CENT.	FAHR.	CENT.
32...	0.	62 ..	16.6	91.4..	33.	121 ..	49.4	152...	66.6	182...	83.3
33...	.5	62.6..	17.	92. ..	33.3	122...	50	152.6.	67	183...	83.8
33.8..	1.	63 ..	17.2	93....	33.8	123..	50.5	153...	67.2	183.2.	84
34 ..	1.1	64 ....	17.7	93.2..	34.	123.8	51.	154...	67.7	184...	84.4
35....	1.6	64.4..	18.	94....	34.4	124...	51.1	154.4.	68.	185...	85
35.6..	2.	65 ....	18.3	95....	35.	125...	51.6	155...	68.3	186...	85.5
36....	2.2	66 ..	18.8	96....	35.5	125.0.	52.	156...	68.8	186.3.	86.
37 ...	2.7	66.2..	19.	96.8..	36.	126...	52.2	156.2.	69.	187...	86.1
37.4..	3.	67 ....	19.4	97....	36.1	127...	52.7	157...	69.4	188...	86.6
38....	3.3	68 ....	20.	98....	36.6	127.4.	53.	158...	70.	188.6.	87
39....	3.8	69....	20.5	98.6..	37.	128...	53.3	159...	70.5	189...	87.2
39.2..	4.	69.8..	21.	99....	37.2	129...	53.8	159.8.	71	190...	87.7
40....	4.4	70....	21.1	100...	37.7	129.2.	54.	160...	71.1	190.4.	88
41....	5.	71....	21.6	100.4.	38.	130...	54.4	161...	71.6	191...	88.1
42....	5.5	71.6..	22.	101...	38.3	131..	55.	161.6.	72.	192...	88.6
42.8..	6.	72 ....	22.2	102...	38.8	132...	55.5	162...	72.2	192.2	89.
43....	6.1	73....	22.7	102.2.	39.	132.8.	56.	163...	72.7	193...	89.4
44....	6.6	73.4..	23.	103...	39.4	133...	56.1	163.4.	73.	194...	90.
44.6..	7.	74....	23.3	104...	40.	134...	56.6	164...	73.3	195...	90.5
45....	7.2	75....	23.8	105...	40.5	134.6.	57.	165...	73.8	195.8.	91.
46....	7.7	75.2..	24.	105.8.	41.	135...	57.2	165.2.	74.	196...	91.1
46.4..	8.	76 ....	24.4	106...	41.1	136...	57.7	166...	74.4	197...	91.6
47....	8.3	77....	25.	107...	41.6	136.4.	58.	167...	75.	197.6.	92.
48....	8.8	78....	25.5	107.6.	42.	137...	58.3	168...	75.5	198...	92.2
48.2..	9.	78.8..	26.	108...	42.2	138 ..	58.8	168.8.	76.	199...	92.7
49....	9.4	79....	26.1	109...	42.7	138.2.	59.	169...	76.1	199.4.	93.
50....	10.	80....	26.6	109.4.	43.	139...	59.4	170...	76.6	200...	93.3
51....	10.5	80.6..	27.	110...	43.3	140...	60.	170.6.	77.	201...	93.8
51.8..	11.	81....	27.2	111...	43.8	141...	60.5	171...	77.2	201.3.	94.
52....	11.1	82....	27.7	111.2.	44.	141.8.	61.	172...	77.7	202...	94.4
53....	11.6	82.4..	28.	112...	44.4	142...	61.1	172.4.	78.	203...	95.
53.6..	12.	83....	28.3	113...	45.	143...	61.6	173...	78.3	204...	95.5
54....	12.2	84 ....	28.8	114...	45.5	143.6.	62.	174...	78.8	204.8.	96.
55....	12.7	84.2..	29.	114.8.	46.	144...	62.2	174.2.	79.	205...	96.1
55.4..	13.	85....	29.4	115...	46.1	145...	62.7	175...	79.4	206...	96.6
56....	13.3	86....	30.	116...	46.6	145.4.	63.	176...	80.	206.6.	97.
57 ...	13.8	87....	30.5	116.6.	47.	146...	63.3	177...	80.5	207...	97.2
57.2..	14	87.8..	31.	117...	47.2	147...	63.8	177.8.	81.	208...	97.7
58....	14.4	88....	31.1	118...	47.7	147.2.	64.	178...	81.1	208.4.	98.
59....	15.	89....	31.6	118.4.	48.	148...	64.4	179...	81.6	209...	98.3
60 ..	15.5	89.6..	32.	119...	48.3	149...	65.	179.6.	82.	210...	98.8
60.8..	16.	90....	32.2	120...	48.8	150...	65.5	180...	82.2	210.2.	99.
61....	16.1	91....	32.7	120.2.	49.	150.8.	66.	181...	82.7	211...	99.4
						151...	66.1	181.4.	83.	212...	100

## SPECIFIC GRAVITIES OF SOLID AND LIQUID ELEMENTS. (WATER=1.)

Lithium.....	.59	Zinc.....	7.10 — 7.20
Potassium .....	.86	Tin.....	7.29 — 7.30
Sodium.....	.97	Iron.....	7.79 — 7.84
Chlorine (liquid).....	1.33	Manganese.....	8.01 — 8.03
Calcium.....	1.58	Cobalt.....	8.49 — 8.51
Magnesium ....	1.70 — 1.74	Nickel.....	8.60 — 8.82
Phosphorus.....	1.83 — 1.96	Cadmium.....	8.45 — 8.69
Sulphur.....	1.98 — 2.07	Molybdenum.....	8.62 — 8.64
Glucinum.....	2.10	Copper.....	8.93 — 8.95
Carbon.....	2.27 — 3.52	Bismuth.....	9.78 — 9.80
Silicon.....	2.49	Silver.....	10.40 — 10.57
Aluminum.....	2.50 — 2.67	Rhodium.....	11.00 — 11.20
Strontium .....	2.54	Lead.....	11.33 — 11.39
Bromine (liquid) ..	2.99 — 3.19	Palladium...	11.80
Selenium.....	4.28 — 4.80	Mercury (liquid.).....	13.60
Iodine.....	4.95	Tungsten.....	17.20 — 18.30
Arsenic .....	5.63 — 5.67	Uranium .....	18.40
Tellurium .....	6.18 — 6.24	Gold.....	19.26 — 19.34
Antimony.....	6.72	Platinum.....	21.50
Chromium.....	7.01	Iridium.....	21.80

## SIMPLE FORMULAS FOR CALCULATING AREAS, SURFACES AND VOLUMES.

$$\pi = 3.1416.$$

### PLANE AREAS.

Triangle, (altitude, $a$ ; base, $b$ ).....	Area =	$\frac{1}{2} ab$ .
Circle, (radius, $R$ ; diameter, $D$ ).....	" =	$\pi R^2$ or $\frac{1}{4} \pi D^2$
Ellipse, (semi-axes, $a$ and $b$ ).....	" =	$\pi ab$ .

### SURFACES OF SOLIDS.

Sphere, (radius, $R$ ; diameter, $D$ ).....	Surface =	$4 \pi R^2$ or $\pi D^2$ .
Cylinder, (radius, $R$ ; height, $h$ ).....	" =	$2(\pi R^2) + (2\pi R)h = 2\pi R(R + h)$ .

### VOLUMES OF SOLIDS.

Sphere, (radius, $R$ ; diameter, $D$ ).....	Volume =	$\frac{4}{3} \pi R^3$ or $\frac{1}{6} \pi D^3$ .
Cylinder or Prism, (height, $h$ ; area of base, $a$ ).....	" =	$ah$ .
Cone or Pyramid, (height, $h$ ; area of base, $a$ ) .....	" =	$\frac{1}{3} ah$ .

## THE C. G. S. SYSTEM OF UNITS.

The C. G. S. System of Units is the result of an attempt to express all quantities with which physical science deals, in terms of three fundamental units:—

A Unit of Length, the centimetre:—

A Unit of Mass, the gramme;

A Unit of Time, the second.

From these the following units are derived:—

Unit of *Surface*; the square centimetre.

“ “ *Volume*; the cubic centimetre.

“ “ *Velocity*; the velocity of one centimetre per second.

“ “ *Acceleration*; the acceleration which imparts unit velocity to a body, in one second.

“ “ *Force*; the dyne; the force, which, acting on a gramme mass for one second, imparts to it a unit of velocity.

“ “ *Work*; the erg; the work done by a dyne working through one centimetre.

“ “ *Energy*; also the erg: since the energy of a body is measured by the amount of work it can do.

“ “ *Heat*; the amount of heat required to raise one gramme of water from  $0^{\circ}$  to  $1^{\circ}$  C.

“ “ *Magnetic Strength*; a magnetic pole has unit strength when it repels a similar pole of equal strength, one centimetre distant, with the force of a dyne.

“ “ *Electric Current* (electro-magnetic system); a current of such strength that one centimetre of its circuit, bent so that every point of it is one centimetre distant from a unit magnetic pole, exerts upon this pole the force of a dyne.

“ “ *Electric Quantity* (electro-magnetic system); the quantity conveyed by a unit current in one second.

“ “ *Difference of Potential* (electro magnetic system); two points have unit difference of potential when one erg of work must be expended to bring a unit of + electricity from one to the other against the electric force.

“ “ *Electric Resistance* (electro-magnetic system); a conductor possesses unit resistance when a unit difference of potential between its ends, causes a unit current to flow through it.

## ALPHABETICAL TABLE OF UNITS USED IN PHYSICAL SCIENCE.

- Ampère**; unit of electric current;  $10^{-1}$  C. G. S. units; the current produced by the difference of potential of a volt through the resistance of an ohm.
- Calorie**; French unit of heat; quantity of heat required to raise one kilogramme of water from  $0^{\circ}$  to  $1^{\circ}$  C; equals 3 968 Eng. units of heat. (See *Heat, English unit of.*)
- Capacity, unit of electric.** See *Farad.*
- Cheval-de-vapeur.** See *Force-de-cheval.*
- Coulomb**; unit of electric quantity;  $10^{-1}$  C. G. S. units; quantity conveyed by the current of an ampère in a second.
- Current, unit of electric.** See *Ampère.*
- Electro-motive force, unit of.** See *Volt.*
- Farad**; unit of electric capacity;  $10^{-9}$  C. G. S. units; quantity which, with the electro-motive force of a volt, would flow through the resistance of an ohm in one second.
- Foot-pound**; English unit of work; work required to raise one pound through one foot in opposition to the force of gravity.
- Force, units of.** See *Kilogramme* and *Pound.*
- Force-de cheval**; French unit of power; .9864 horse-power; power of doing 75 kilogrammetres (542.5 foot-pounds) of work per second.
- Heat, English unit of**; heat required to raise one pound of water from  $32^{\circ}$  to  $33^{\circ}$  F. (See *Calorie.*)
- Horse-power**; English unit of power; power required to perform 550 foot-pounds of work per second.
- Kilogramme**; French unit of mass, and also of force. (See *Pound.*)
- Kilogrammetre**; French unit of work; work required to raise one kilogramme of mass through one metre in opposition to force of gravity.
- Mass, units of.** See *Kilogramme* and *Pound.*
- Ohm**; unit of electric resistance;  $10^9$  C. G. S. units; is the resistance offered to a current of electricity by a wire of pure silver or copper one millimetre in diameter and 48.61 metres long at  $65^{\circ}$  F ( $18\ 3^{\circ}$  C).
- Potential, unit difference of.** See *Volt.*
- Pound**; English unit of mass; regarded as a *weight* it is used also as the unit of force, i. e. the force exercised by the mass of a pound (where  $g = 981$ : London).
- Power, unit of.** See *Force-de-cheval* and *Horse-power.*
- Power, unit of electric.** See *Watt.*
- Quantity, unit of electric.** See *Coulomb.*
- Quantity, unit of magnetic.** See *Weber.*
- Resistance, unit of electric.** See *Ohm.*
- Volt**; unit of electro-motive force;  $10^8$  C. G. S. units; equals 9208 of the force of one Daniell cell.
- Watt**; unit of electric power;  $10^7$  C. G. S. units; power exerted by the current of an ampère through the difference of potential of a volt.
- Weber**; unit of magnetic quantity;  $10^9$  C. G. S. units.
- Work, units of.** See *Foot-pound* and *Kilogrammetre.*



TABLE OF LOGARITHMS.

Nat. Numb.	0	1	2	3	4	5	6	7	8	9	PROPORTIONAL PARTS.								
											1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1100	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2526	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2715	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5158	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5341	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5889	5900	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10

TABLE OF LOGARITHMS.

Nat. Numb.	PROPORTIONAL PARTS.									
	0	1	2	3	4	5	6	7	8	9
40	0021	6031	0042	0053	0064	0075	0085	6096	0107	6117
41	0128	0138	0149	0160	0170	0181	0191	0201	0212	6222
42	0232	6243	0253	0264	0274	0284	0294	0304	0314	6325
43	0335	6345	0355	0365	0375	0385	0395	0405	0415	6425
44	0435	6444	0454	0464	0474	0484	0493	0503	0513	6522
45	6532	6542	6551	6561	6571	6581	6590	6600	6610	6618
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396
55	7404	7412	7419	7427	7435	7443	7451	7459	7467	7474
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551
57	7566	7574	7582	7590	7598	7606	7614	7621	7629	7637
58	7634	7642	7650	7657	7664	7672	7679	7686	7694	7701
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445

TABLE OF LOGARITHMS.

Nat. Numb.	PROPORTIONAL PARTS.									
	0	1	2	3	4	5	6	7	8	9
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	
71	8463	8469	8475	8481	8487	8493	8499	8505	8511	4
72	8475	8481	8487	8493	8499	8505	8511	8517	8523	4
73	8487	8493	8499	8505	8511	8517	8523	8529	8535	4
74	8499	8505	8511	8517	8523	8529	8535	8541	8547	4
75	8511	8517	8523	8529	8535	8541	8547	8553	8559	4
76	8523	8529	8535	8541	8547	8553	8559	8565	8571	4
77	8535	8541	8547	8553	8559	8565	8571	8577	8583	4
78	8547	8553	8559	8565	8571	8577	8583	8589	8595	4
79	8559	8565	8571	8577	8583	8589	8595	8601	8607	4
80	8571	8577	8583	8589	8595	8601	8607	8613	8619	4
81	8583	8589	8595	8601	8607	8613	8619	8625	8631	4
82	8595	8601	8607	8613	8619	8625	8631	8637	8643	4
83	8607	8613	8619	8625	8631	8637	8643	8649	8655	4
84	8619	8625	8631	8637	8643	8649	8655	8661	8667	4
85	8631	8637	8643	8649	8655	8661	8667	8673	8679	4
86	8643	8649	8655	8661	8667	8673	8679	8685	8691	4
87	8655	8661	8667	8673	8679	8685	8691	8697	8703	4
88	8667	8673	8679	8685	8691	8697	8703	8709	8715	4
89	8679	8685	8691	8697	8703	8709	8715	8721	8727	4
90	8691	8697	8703	8709	8715	8721	8727	8733	8739	4
91	8703	8709	8715	8721	8727	8733	8739	8745	8751	4
92	8715	8721	8727	8733	8739	8745	8751	8757	8763	4
93	8727	8733	8739	8745	8751	8757	8763	8769	8775	4
94	8739	8745	8751	8757	8763	8769	8775	8781	8787	4
95	8751	8757	8763	8769	8775	8781	8787	8793	8799	4
96	8763	8769	8775	8781	8787	8793	8799	8805	8811	4
97	8775	8781	8787	8793	8799	8805	8811	8817	8823	4
98	8787	8793	8799	8805	8811	8817	8823	8829	8835	4
99	8799	8805	8811	8817	8823	8829	8835	8841	8847	4

TABLE OF ANTI-LOGARITHMS.

Logs.	0	1	2	3	4	5	6	7	8	9	PROPORTIONAL PARTS.									
											1	2	3	4	5	6	7	8	9	
.0	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	2	2	2	2
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	2	2	2	2
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	2	2	2	2
.03	1072	1074	1076	1078	1081	1084	1085	1087	1091	1094	0	0	1	1	1	1	2	2	2	2
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	2	2	2	2	2
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	9	1	1	1	1	2	2	2	2	2
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	2	2	2	2	2
.07	1175	1178	1180	1183	1186	1188	1191	1194	1197	1199	0	1	1	1	1	2	2	2	2	2
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	2	2	2	2	2
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	2	2	2	2	2
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	2	2	2	2	2
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	1	2	2	2	2	2
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	1	2	2	2	2	2
.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	1	2	2	2	2	2
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	1	2	2	2	2	2
.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	1	2	2	2	2	2
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	1	2	2	2	2	2
.17	1478	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	1	2	2	2	2	2
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	1	2	2	2	2	2
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	1	2	2	2	2	2
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	1	2	2	2	2	2
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	1	1	2	2	2	2	2
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	1	1	2	2	2	2	2
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	1	1	2	2	2	2	2
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	1	1	2	2	2	2	2
.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	1	1	2	2	2	2	2
.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	1	1	2	2	2	2	2
.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	1	1	2	2	2	2	2
.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	1	1	2	2	2	2	2
.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	1	1	2	2	2	2	2

TABLE OF ANTI-LOGARITHMS.

Logs	0	1	2	3	4	5	6	7	8	9	PROPORTIONAL PARTS.								
											1	2	3	4	5	6	7	8	9
.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2	3	3	4	4
.31	2042	2047	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2	3	3	4	4
.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2	3	3	4	4
.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2	3	3	4	4
.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3	3	4	4	5
.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3	3	4	4	5
.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3	3	4	4	5
.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3	3	4	4	5
.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3	3	4	4	5
.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3	3	4	4	5
.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3	4	4	5	5
.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3	4	4	5	5
.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3	4	4	5	5
.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	3	3	4	4	5	5
.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3	4	4	5	5
.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	4	4	5	5	5
.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	4	4	5	5	5
.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	4	4	5	5	5
.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	4	4	5	5	5
.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4	4	5	5	5
.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	5	5
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	2	2	3	4	5	5	6	6
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	2	2	3	4	5	5	6	6
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4	5	5	6	6
.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4	5	5	6	6
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4	5	5	6	6
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	3	3	4	5	5	6	6
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4	5	5	6	6
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	3	4	5	5	6	6
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5	5	6	6	6



TABLE OF ANTI-LOGARITHMS.

Logs.	0										PROPORTIONAL PARTS.									
	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9		
.60	3.001	3.009	3.018	3.027	3.036	3.045	3.054	3.063	3.072	3.081	3.090	3.099	3.108	3.117	3.126	3.135	3.144	3.153		
.61	3.074	3.083	3.092	3.101	3.110	3.119	3.128	3.137	3.146	3.155	3.164	3.173	3.182	3.191	3.200	3.209	3.218	3.227		
.62	3.119	3.128	3.137	3.146	3.155	3.164	3.173	3.182	3.191	3.200	3.209	3.218	3.227	3.236	3.245	3.254	3.263	3.272		
.63	3.220	3.229	3.238	3.247	3.256	3.265	3.274	3.283	3.292	3.301	3.310	3.319	3.328	3.337	3.346	3.355	3.364	3.373		
.64	3.385	3.394	3.403	3.412	3.421	3.430	3.439	3.448	3.457	3.466	3.475	3.484	3.493	3.502	3.511	3.520	3.529	3.538		
.65	3.447	3.456	3.465	3.474	3.483	3.492	3.501	3.510	3.519	3.528	3.537	3.546	3.555	3.564	3.573	3.582	3.591	3.600		
.66	3.571	3.580	3.589	3.598	3.607	3.616	3.625	3.634	3.643	3.652	3.661	3.670	3.679	3.688	3.697	3.706	3.715	3.724		
.67	3.677	3.686	3.695	3.704	3.713	3.722	3.731	3.740	3.749	3.758	3.767	3.776	3.785	3.794	3.803	3.812	3.821	3.830		
.68	3.786	3.795	3.804	3.813	3.822	3.831	3.840	3.849	3.858	3.867	3.876	3.885	3.894	3.903	3.912	3.921	3.930	3.939		
.69	3.868	3.877	3.886	3.895	3.904	3.913	3.922	3.931	3.940	3.949	3.958	3.967	3.976	3.985	3.994	4.003	4.012	4.021		
.70	4.012	4.021	4.030	4.039	4.048	4.057	4.066	4.075	4.084	4.093	4.102	4.111	4.120	4.129	4.138	4.147	4.156	4.165		
.71	4.156	4.165	4.174	4.183	4.192	4.201	4.210	4.219	4.228	4.237	4.246	4.255	4.264	4.273	4.282	4.291	4.300	4.309		
.72	4.248	4.257	4.266	4.275	4.284	4.293	4.302	4.311	4.320	4.329	4.338	4.347	4.356	4.365	4.374	4.383	4.392	4.401		
.73	4.370	4.379	4.388	4.397	4.406	4.415	4.424	4.433	4.442	4.451	4.460	4.469	4.478	4.487	4.496	4.505	4.514	4.523		
.74	4.495	4.504	4.513	4.522	4.531	4.540	4.549	4.558	4.567	4.576	4.585	4.594	4.603	4.612	4.621	4.630	4.639	4.648		
.75	4.623	4.632	4.641	4.650	4.659	4.668	4.677	4.686	4.695	4.704	4.713	4.722	4.731	4.740	4.749	4.758	4.767	4.776		
.76	4.754	4.763	4.772	4.781	4.790	4.799	4.808	4.817	4.826	4.835	4.844	4.853	4.862	4.871	4.880	4.889	4.898	4.907		
.77	4.885	4.894	4.903	4.912	4.921	4.930	4.939	4.948	4.957	4.966	4.975	4.984	4.993	5.002	5.011	5.020	5.029	5.038		
.78	5.026	5.035	5.044	5.053	5.062	5.071	5.080	5.089	5.098	5.107	5.116	5.125	5.134	5.143	5.152	5.161	5.170	5.179		
.79	5.166	5.175	5.184	5.193	5.202	5.211	5.220	5.229	5.238	5.247	5.256	5.265	5.274	5.283	5.292	5.301	5.310	5.319		
.80	5.310	5.319	5.328	5.337	5.346	5.355	5.364	5.373	5.382	5.391	5.400	5.409	5.418	5.427	5.436	5.445	5.454	5.463		
.81	5.457	5.466	5.475	5.484	5.493	5.502	5.511	5.520	5.529	5.538	5.547	5.556	5.565	5.574	5.583	5.592	5.601	5.610		
.82	5.607	5.616	5.625	5.634	5.643	5.652	5.661	5.670	5.679	5.688	5.697	5.706	5.715	5.724	5.733	5.742	5.751	5.760		
.83	5.761	5.770	5.779	5.788	5.797	5.806	5.815	5.824	5.833	5.842	5.851	5.860	5.869	5.878	5.887	5.896	5.905	5.914		
.84	5.915	5.924	5.933	5.942	5.951	5.960	5.969	5.978	5.987	5.996	6.005	6.014	6.023	6.032	6.041	6.050	6.059	6.068		
.85	6.079	6.088	6.097	6.106	6.115	6.124	6.133	6.142	6.151	6.160	6.169	6.178	6.187	6.196	6.205	6.214	6.223	6.232		
.86	6.244	6.253	6.262	6.271	6.280	6.289	6.298	6.307	6.316	6.325	6.334	6.343	6.352	6.361	6.370	6.379	6.388	6.397		
.87	6.413	6.422	6.431	6.440	6.449	6.458	6.467	6.476	6.485	6.494	6.503	6.512	6.521	6.530	6.539	6.548	6.557	6.566		
.88	6.586	6.595	6.604	6.613	6.622	6.631	6.640	6.649	6.658	6.667	6.676	6.685	6.694	6.703	6.712	6.721	6.730	6.739		
.89	6.762	6.771	6.780	6.789	6.798	6.807	6.816	6.825	6.834	6.843	6.852	6.861	6.870	6.879	6.888	6.897	6.906	6.915		

## TABLE OF ANTI-LOGARITHMS.

Leg.	0	1	2	3	4	5	6	7	8	9	PROPORTIONAL PARTS.								
											1	2	3	4	5	6	7	8	9
.50	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9	11	13	15	17
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9	11	13	15	17
.92	8311	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10	12	14	15	17
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10	12	14	16	18
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10	12	14	16	18
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10	12	15	17	19
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	8	11	13	15	17	19
.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	7	9	11	13	15	17	20
.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11	13	16	18	20
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11	14	16	18	20

## GUIDE TO THE USE OF THE FOREGOING TABLES.

Logarithm .....	3.3181	Logarithm .....	2.08	3.181
" .....	2.3181	" .....	.208	1.318
" .....	1.3181	" .....	.208	2.3181
Find Logarithm of 4026.				
Logarithm 4020 .....	3.6042	Find Natural Number for Logarithm 3.2432.		
Proportional part for 6 .....	6	Number for Logarithm 3.2430 .....	1750.	
		Add proportional part 2, .....	1.	
Logarithm required .....	3.6048	Natural number required, .....	1751.	

To **MULTIPLY** by use of Logarithms: Add together the logarithms of the numbers to be multiplied; the sum is a logarithm whose natural number is the product required.

To DIVIDE by use of *Logarithms*: Subtract the logarithm of the divisor from the logarithm of dividend; the difference is a logarithm whose natural number is the quotient required.

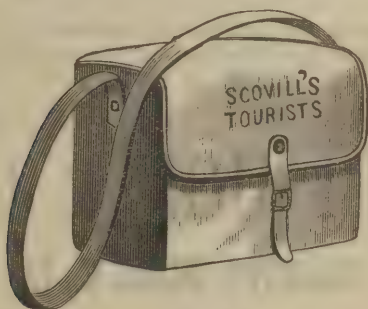
To EXTRACT A ROOT by use of Logarithms: Divide the logarithm of the number (whose root is to be extracted) by the index of the root; the quotient is the logarithm of the required root.

TO RAISE A NUMBER TO ANY POWER: Multiply the logarithm of the number (to be raised) by the index of the power; the product is the logarithm of the required number.

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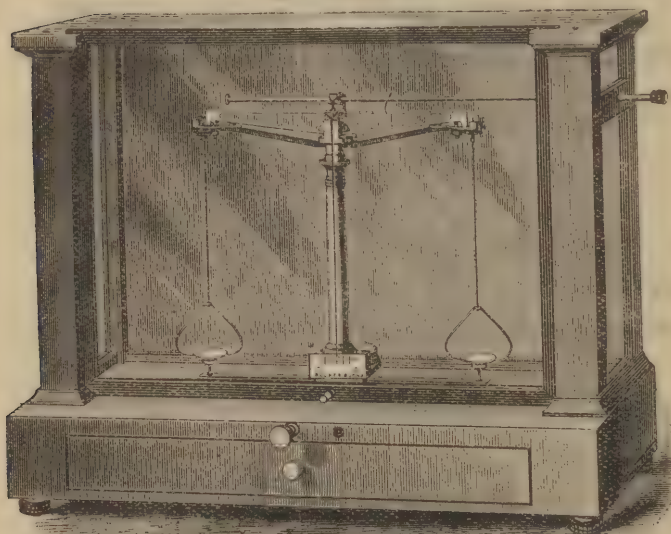
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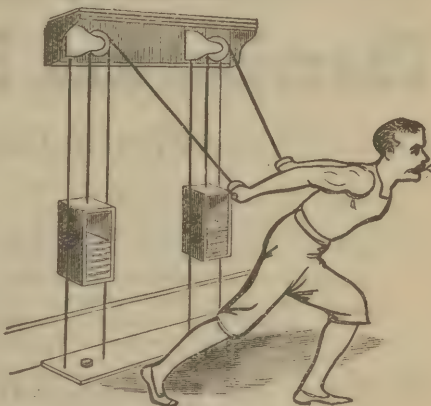
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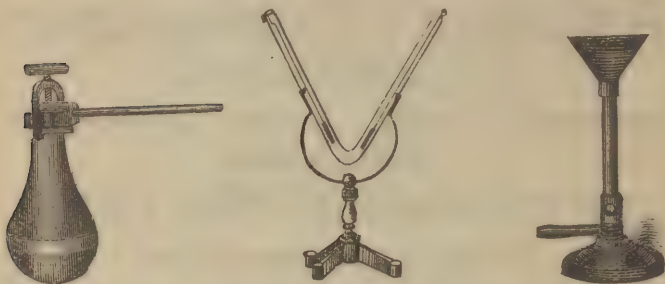
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

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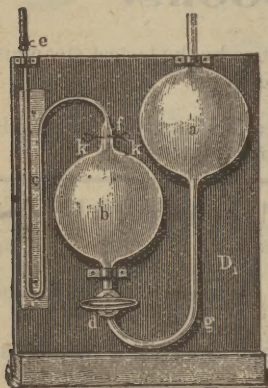
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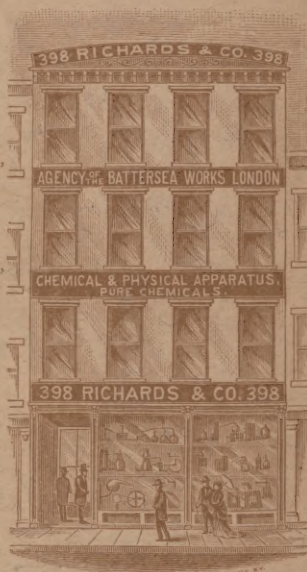
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